SOME ORGANIZING PRINCIPLES IN MAN MACHINE INTERACTION

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Abstract

The organizing concepts of motivation, learning, and feedback are used as a form for discussion of man machine interaction.

Summary

I will attempt in this paper to abstract some properties of well-designed generalized machines (instruments) that from my point of view make them exceptionally useful. The emphasis on generalized machines, to the exclusion of specialized machines, is motivated by the belief that we as a culture know how to design specialized user-oriented machines, especially machines which require the user to employ aspects of his being in addition to the purely rational.

Motivation

In many situations, the motivation for using a device is external, i.e., grades, conditions of employment, etc., however, intrinsic motivation is often desirable. First, of course, is that the device should do something that humans want or need to do. Second is that the device should be pleasant to use. This is true of motorcycles, violins, and sound synthesizers, and should be true of computer-based educational, information retrieval, and graphics systems! The social and physical environment in which the device is placed is also of high importance. Comfort and pleasure are essentially human considerations and require becoming sensitive to how people feel in certain circumstances. Introspection is a good tool.

Direction of Action

People should control machines, not vice versa. This misplaced control is most common in educational systems where the student is directed through material with only a small number of options, often needlessly forced to learn things in a particular sequence. Healthy people like to be in control of their lives, even the details.

The speed of feedback is one of the most commonly discussed properties of computer systems. It can, of course, vary from days to no perceivable delay. Real time computing can be loosely defined as computing with no perceivable delay. As the speed of feedback approaches real time, some very interesting things happen. For example, the monitor feature of a tape recorder is used to delay the sound coming back to a human speaker by a few tenths of a second. This so drastically interferes with the speaking process as to make normal speech impossible until the speaker learns to ignore the delayed feedback. This should not be surprising. Delays in feedback loops often cause instabilities. One sixtieth of a second delay in my experience has always felt real time and not caused anomalous behavior.

Systems with extensive feedback can simplify problems and sometimes obviate the need for specialized algorithms. For instance, if two objects on the display screen need to be lined up in some manner, it is much easier to move the objects on dials and line them up than to algorithmically find the positions of corresponding points and write a program to align the object. Another example, if a smooth zoom through an object is needed, have a human move a dial smoothly rather than calculate a curve with continuous derivatives. Problems of immense complexity can often be solved by providing immensely good feedback to the human operator. Can you imagine, for instance, playing a Bach fugue on an organ with delayed feedback? Automated performance of redundant elements would be very small compensation!

!! How else?

Conclusion

The importance of good, fluid man machine design cannot be overstressed. Developed countries are entering a period where much of human experience is going to be related to the use of sophisticated electronic devices designed by us. Whether this world is going to be pleasant, fluid, and evolving or cold, frigid, and inflexible will be in good part determined by how well we do our jobs. Designing for human use is a highly complex task. It is a highly technical task. But most importantly, it is a highly human task. It is as important to feel as it is to think. It is as important to watch how people interact with objects and other people as it is to keep up with the technology. It is important to be sensitive to yourself and to pay attention to how humans do things. After all, humans are (perhaps) the most sophisticated and generalized entities available for modeling.

All users of all systems must learn to use the systems. Learning is an integral requirement of the design of user-oriented systems. As systems become more general, more powerful, and more complex, a larger percentage of time is spent learning the system. A user, even after months or years, may still be spending a percentage of time learning new implications.

It is a virtue to not have to rely on particular kinds of background (for instance, familiarity with computer systems) that the user may not have. It is also a virtue for the system to teach itself. If these goals can be achieved, the system will be usable

by people of widely varying levels of competence anc experience. Sophisticated help commands are very us ful and necessary in most linguistically-based syste However, this is just the beginning! Structural uni or conceptual unity is important. For example, a cc mand form or a kind of knob or a kind of connector should bear a strong relationship to function. Thir that look alike should do alike. Similar commands a different levels of a system should behave and look similar. In a sense, one ought to be able to infer both intuitively and rationally what the structure c meaning of another command or knob is from the comma or knobs already learned. This is a subtle propert, but not uncommon. Natural languages have this feat. One can construct a statement in the language from knowledge of other statements.

Feedback

The importance of the amount, kind, and quality of feedback cannot be over-emphasized. I am sure you are aware that a great range of human activities depend strongly on feedback. Walking across a room to turn off a light is much less dependent on weight of clothing or stiffness of muscles than accurate feedback. Try it with reversing glasses! Driving a car at sixty miles per hour would be impossible without a vast variety of visual, tactile, and auditory feedback. Good feedback can cover for a huge range of difficult situations because it enables the human operator to act fully using capabilities of extreme sophistication compared to anything non-biological.

Feedback implies a closed loop containing input devices. The most common non-linguistic input devices designed for humans are the knob, slider pot, joy stick, and drawing tablet. Many of these devices have been used for many years on analog machines. They are well-designed for good feel and are capable of responding to very fine control. In many cases, however, when employed in digital systems, they are crowded close together with small knobs and placed in physically uncomfortable places. The quality of feedback is strongly dependent on the quality of input. They are in the same loop.